

PRELIMINARY DATA SUMMARY

June 1988

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

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CERC Field Research Facility
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Field Research Facility Measurement and Analysis Work Unit at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Herman C. Miller at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

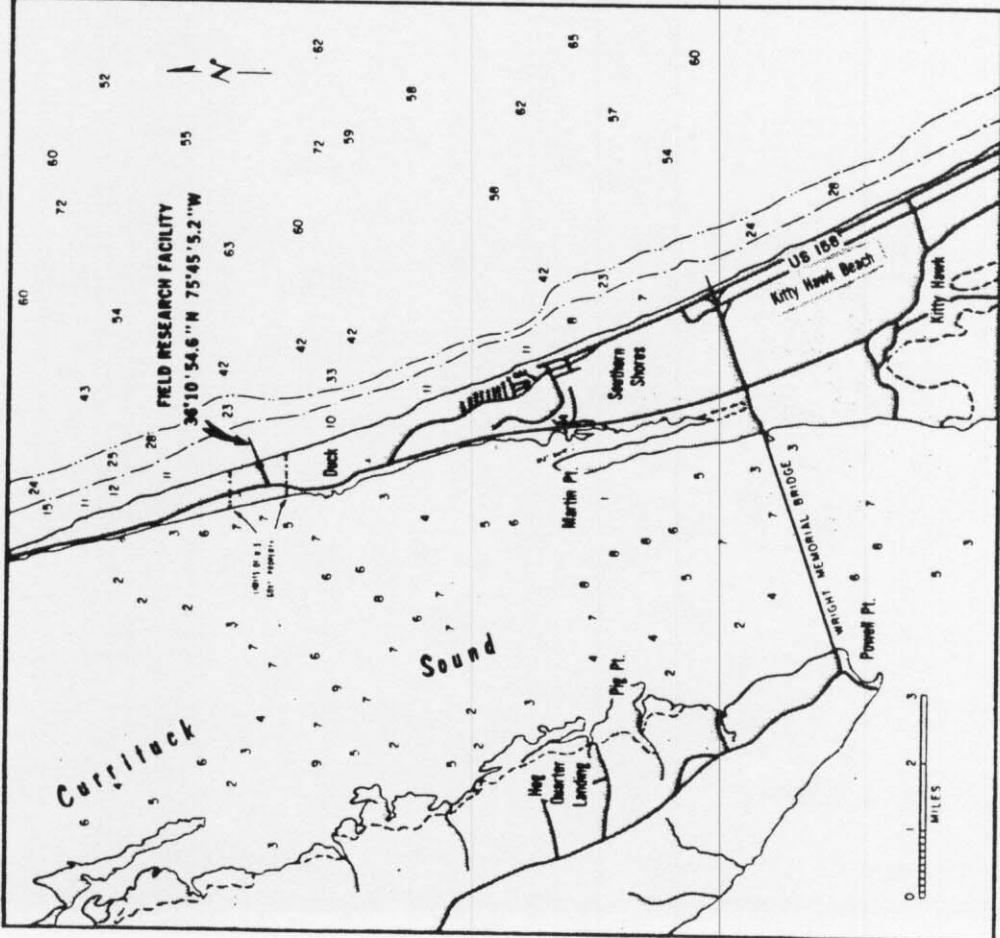
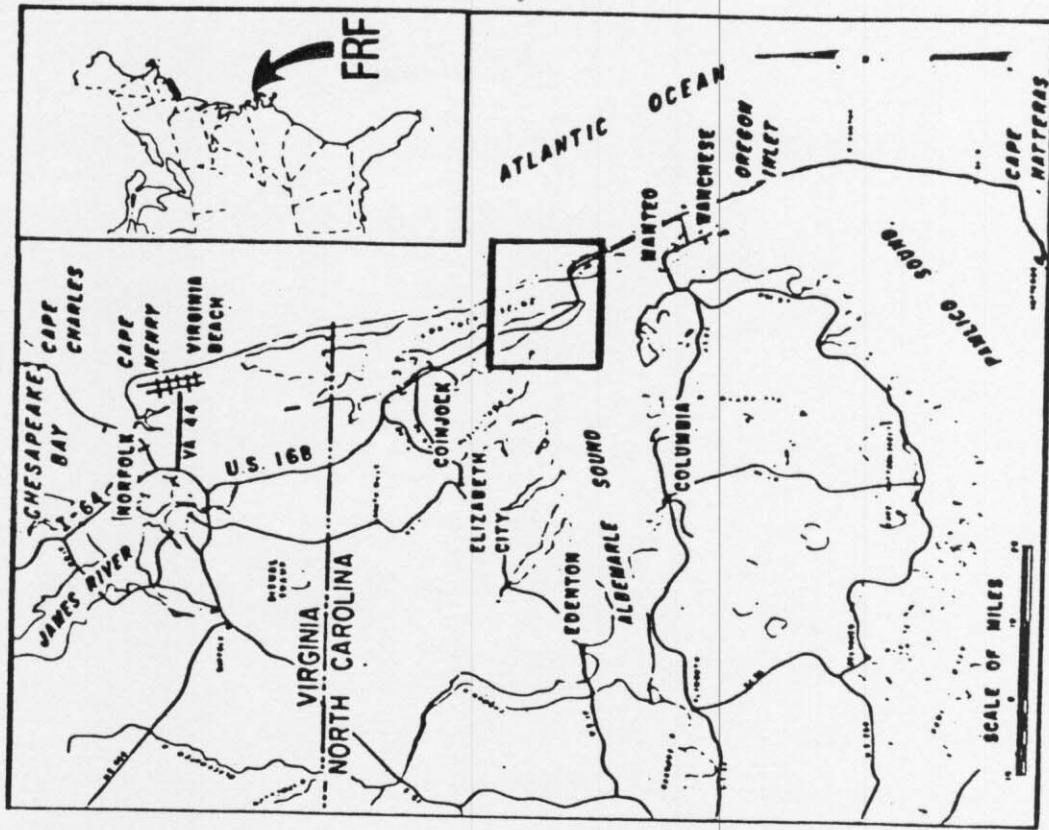


Figure 1. FRF location map

Table 1: Instrument Status/Data Availability

JUN 1988

Gage ID	Description/Remarks	Depth at Sensor	Day of the month																														
			1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	
616	Barometric Pressure		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*
			Analog Record	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
604	Precipitation		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*
624	Air Temperature		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*
632	Anemometer on Laboratory Building Elevation 19 m (NGVD)		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*
			Analog Record	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
645	Baylor staff at station 7+80 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*
625	Baylor staff at station 19+00 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*
111	Pressure gage 309 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*
630	Waverider buoy 6.0 km offshore	Approx. 23 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	/
679	Current meter 500 m south of FRF pier (0.5 km offshore)	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
865-1370	NOAA tide station at seaward end of FRF pier		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Supplemental Observations (daily oceanographic and meteorological observations)			Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -

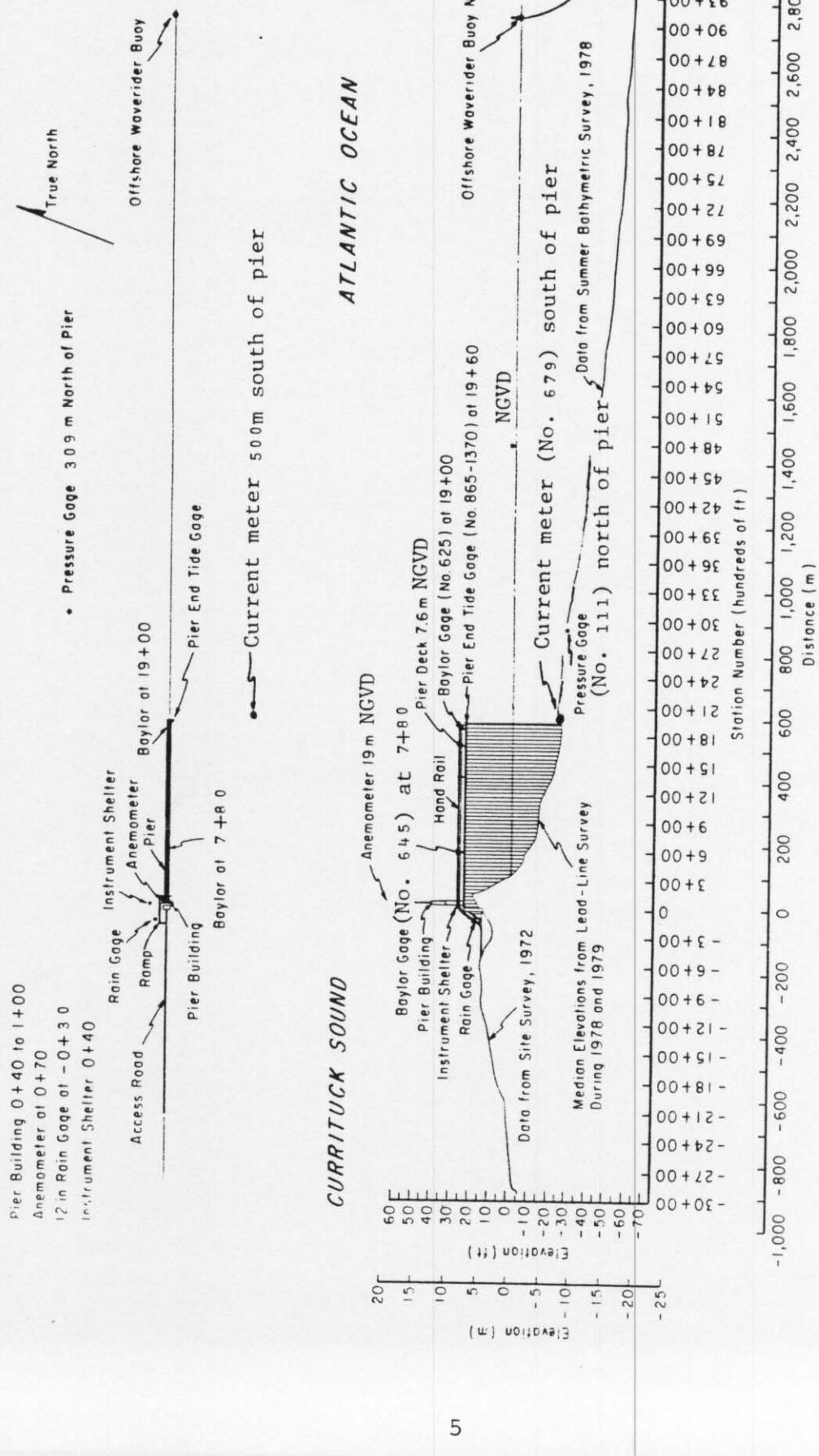


Figure 2. Instrument locations at FRF

PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured on top of the laboratory building at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

Table 2: Meteorological Data

JUN 1988

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	5	235	24.8	1012.8	0
	700	4	270	25.4	1012.5	0
	1300	5	232	31.3	1009.8	0
	1900	5	238	27.9	1006.4	0
2	100	6	262	25.6	1005.0	0
	700	11	37	17.3	1009.1	0
	1300	8	51	16.6	1011.4	0
	1900	10	47	15.4	1012.1	0
3	100	8	62	15.8	1010.1	0
	700	14	54	14.8	1006.0	3
	1300	9	56	14.5	1007.0	22
	1900	15	17	14.4	1008.7	2
4	100	12	11	13.7	1010.4	0
	700	13	23	13.7	1012.5	0
	1300	7	21	15.7	1015.2	0
	1900	3	95	14.5	1016.5	0
5	100	4	246	15.6	1017.9	0
	700	6	263	17.0	1018.9	0
	1300	6	256	22.8	1016.9	0
	1900	8	250	21.2	1013.5	0
6	100	9	247	19.8	1011.8	0
	700	8	256	20.7	1011.4	0
	1300	4	10	24.8	1010.8	0
	1900	3	94	23.7	1009.4	0
7	100	6	243	22.6	1008.4	0
	700	4	259	24.2	1008.4	0
	1300	5	233	31.9	1006.0	0
	1900	3	246	27.0	1005.0	0
8	100	6	239	24.5	1005.0	0
	700	4	253	24.4	1005.4	0
	1300	5	36	24.2	1005.0	0
	1900	4	322	21.9	1004.3	0
9	100	6	209	24.3	1004.3	0
	700	6	194	24.4	1003.3	0
	1300	12	11	17.9	1005.7	0
	1900	14	29	15.9	1008.7	6
10	100	11	36	14.7	1011.4	11
	700	11	33	15.6	1015.9	0
	1300	8	25	16.1	1016.9	0
	1900	5	59	15.4	1017.2	0
11	100	4	26	15.3	1017.5	0
	700	6	326	16.7	1018.2	0
	1300	11	357	19.7	1018.6	0
	1900	3	346	18.3	1019.2	0
12	100	5	241	18.0	1020.3	0
	700	5	256	19.8	1021.6	0
	1300	5	235	25.5	1021.3	0
	1900	4	211	23.1	1020.3	0
13	100	7	233	19.8	1022.3	0
	700	4	238	21.6	1024.0	0
	1300	4	234	27.4	1024.3	0
	1900	3	174	24.6	1023.6	0
14	100	6	225	20.9	1025.0	0
	700	6	249	22.3	1026.3	0
	1300	3	202	28.5	1026.3	0
	1900	5	186	24.9	1024.7	0
15	100	5	218	21.9	1025.0	0
	700	5	239	23.0	1025.0	0
	1300	3	162	27.9	1023.3	0
	1900	5	184	24.3	1021.3	0
16	100	4	223	22.5	1020.3	0
	700	2	210	23.2	1019.9	0
	1300	5	126	24.6	1017.9	0
	1900	4	147	21.0	1015.9	0

(Continued)

(Sheet 1 of 2)

Table 2: Meteorological Data

JUN 1988

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
17	100	3	147	20.5	1014.5	0
	700	4	216	23.8	1014.8	0
	1300		Preventive Maintenance		1014.5	0
	1900	4	163	22.0	1014.5	0
18	100	4	213	22.4	1016.2	5
	700	4	136	20.4	1018.2	0
	1300	4	231	27.1	1019.6	0
	1900	3	119	21.6	1019.6	0
19	100	3	217	23.5	1020.9	0
	700	4	233	25.1	1022.6	0
	1300	5	122	26.6	1022.3	0
	1900	4	149	23.1	1021.6	0
20	100	5	208	24.6	1021.6	0
	700	6	234	24.9	1022.6	0
	1300	4	145	27.6	1020.3	0
	1900	6	185	26.3	1018.2	0
21	100	8	221	24.3	1018.2	0
	700	7	235	24.5	1017.2	0
	1300	5	206	30.6	1015.2	0
	1900	5	180	28.0	1014.2	0
22	100	6	208	25.1	1014.8	0
	700	7	208	25.7	1015.2	0
	1300	6	167	32.1	1013.8	0
	1900	6	172	26.9	1013.5	0
23	100	6	185	25.6	1013.8	0
	700	8	194	26.6	1013.8	0
	1300	5	191	32.8	1011.8	0
	1900	5	177	28.8	1011.8	0
24	100	9	35	20.4	1015.5	0
	700	11	50	18.7	1017.2	10
	1300	7	1	20.6	1020.3	0
	1900	8	48	19.6	1019.9	0
25	100	8	57	19.0	1020.3	0
	700	5	53	19.6	1020.3	0
	1300	4	52	21.3	1018.9	0
	1900	5	103	20.1	1015.2	0
26	100	5	192	22.2	1012.8	0
	700	6	205	25.0	1010.8	0
	1300	7	206	30.5	1006.7	0
	1900	5	343	20.2	1006.4	24
27	100	6	325	20.8	1007.4	24
	700	9	19	19.5	1010.4	0
	1300	7	33	20.3	1012.1	0
	1900	5	33	19.1	1013.1	0
28	100	2	298	16.5	1013.8	0
	700	4	300	21.3	1015.2	0
	1300	3	212	27.1	1014.8	0
	1900	4	167	23.9	1013.8	0
29	100	6	221	22.7	1014.2	0
	700	8	229	21.7	1013.8	0
	1300	6	225	27.3	1011.1	0
	1900	5	202	26.0	1009.8	0
30	100	4	250	21.9	1009.1	5
	700	5	263	21.0	1008.4	6
	1300	6	6	20.8	1007.7	0
	1900	1	93	19.8	1007.7	0
Resultant				Mean	Total	
		1	241	22.2	1014.8	118

(Sheet 2 of 2)

PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hrs (more frequently during storms) near 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for 34 minutes.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all H_{mo} and T_p values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Jun 1988

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo,m T,sec	Baylor at 19+00	Hmo,m T,sec	Pressure Gage	Hmo,m T,sec	Farshir Wvdr	Hmo,m T,sec
17	0100	0.18	8.83	0.59	8.53	0.63	8.26	0.68	8.83
	0700	0.26	8.26	0.59	8.26	0.61	8.53	0.70	8.26
	1300					Preventive Maintenance			
	1900	0.43	8.83	0.74	8.53	0.74	8.53	0.95	8.83
18	0100	0.31	9.14	0.76	8.83	0.77	8.53	0.78	8.53
	0700	0.30	8.83	0.73	8.26	0.73	8.83	0.79	8.53
	1300	0.28	8.53	0.65	8.83	0.66	8.26	0.64	8.00
	1900	0.28	8.83	0.64	8.00	0.66	8.26	0.69	8.00
19	0100	0.32	8.00	0.62	9.14	0.62	8.26	0.74	8.00
	0700	0.20	8.26	0.59	8.53	0.64	8.00	0.72	8.00
	1300	0.28	8.53	0.59	8.00	0.60	8.00	0.66	8.00
	1900	0.32	8.26	0.70	7.76	0.66	8.00	0.74	7.76
20	0100	0.25	8.00	0.59	8.00	0.60	7.53	0.70	7.76
	0700	0.18	8.00	0.56	7.76	0.60	7.76	0.63	7.76
	1300	0.24	8.53	0.54	9.14	0.58	8.26	0.62	8.53
	1900	0.24	2.98	0.56	9.85	0.62	8.00	0.65	8.26
21	0100	0.25	9.48	0.46	8.26	0.51	9.14	0.63	7.76
	0700	0.17	8.26	0.42	9.14	0.45	8.83	0.53	7.76
	1300	0.19	8.83	0.41	9.48	0.45	8.83	0.46	8.53
	1900	0.20	8.83	0.38	9.48	0.42	9.48	0.50	9.48
22	0100	0.21	15.06	0.36	8.83	0.39	9.14	0.48	8.00
	0700	0.20	2.72	0.36	8.53	0.42	9.48	0.45	9.48
	1300	0.34	2.91	0.47	9.48	0.44	8.53	0.57	8.83
	1900	0.26	2.94	0.50	9.48	0.48	10.24	0.72	4.00
23	0100	0.34	9.85	0.54	9.85	0.58	9.85	0.79	4.74
	0700	0.29	2.59	0.46	9.14	0.53	9.14	0.79	9.14
	1300	0.33	9.14	0.52	9.48	0.53	9.14	0.74	4.57
	1900	0.28	3.05	0.50	5.22	0.52	8.53	0.72	4.83
24	0100	0.49	3.20	0.68	3.12	0.60	3.37		
	0700	1.07	5.57	1.64	6.09	1.66	5.57		
	1300	1.03	5.95	1.14	5.95	1.06	5.82		
	1900	1.08	6.24	1.37	6.40	1.28	6.24		
25	0100	1.10	6.24	1.47	6.92	1.34	6.40		
	0700	0.83	7.53	1.22	7.53	1.09	7.53		
	1300	0.65	6.56	1.11	6.92	1.17	6.74		
	1900	0.54	6.40	0.98	9.14	1.02	8.53		
26	0100	0.41	8.53	0.96	9.48	0.96	9.14		Gage
	0700	0.27	8.83	0.71	8.83	0.72	9.14		Inoperative
	1300	0.31	8.53	0.57	8.53	0.60	9.14		
	1900	0.63	3.77	0.80	3.94	0.76	3.88		
27	0100	0.34	4.34	0.68	8.26	0.64	8.00		
	0700	1.07	4.92	1.27	4.66	1.18	4.92		
	1300	1.05	5.95	1.23	5.95	1.18	5.69		
	1900	0.77	5.95	0.91	6.56	0.94	10.24		
28	0100	0.66	6.24	0.97	9.85	0.97	9.85		
	0700	0.63	5.45	0.84	9.48	0.88	9.85		
	1300	0.27	9.85	0.79	9.85	0.83	9.48	0.80	9.85
	1900	0.35	9.85	0.64	10.24	0.70	9.48	0.75	9.14
29	0100	0.28	9.85	0.60	8.83	0.72	9.85	0.84	9.85
	0700	0.29	9.48	0.71	9.85	0.77	9.85	0.79	9.85
	1300	0.23	9.48	0.66	9.14	0.77	9.48	0.74	9.48
	1900	0.38	9.48	0.69	9.48	0.81	9.48	0.86	9.48
30	0100	0.24	9.14	0.69	9.14	0.74	9.14	0.77	9.48
	0700	0.28	8.83	0.55	8.83	0.70	9.48	0.71	8.83
	1300	0.24	10.24	0.52	8.83	0.53	9.48	0.59	9.14
	1900	0.43	3.71	0.60	8.53	0.62	8.83	0.66	8.83
	Mean	0.46	7.91	0.73	8.60	0.75	8.41	0.77	7.94
	Std dev	0.37	3.42	0.48	2.19	0.46	2.16	0.49	1.96

* Electronic problems

(Sheet 2 of 2)

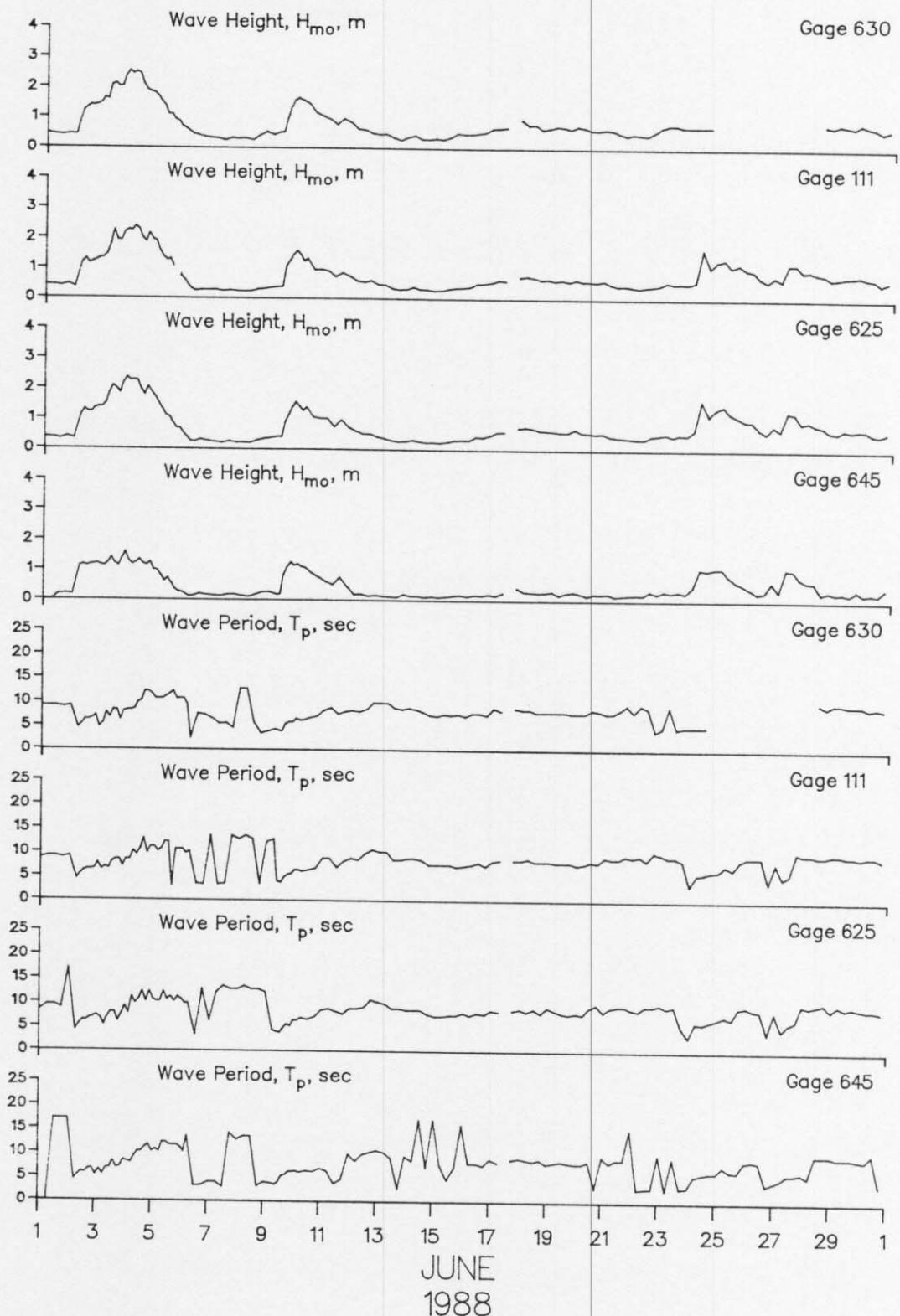


Figure 3. Time history of wave heights and periods

PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data
Jun 1988

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter at South Tripod				
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	Depth -4.8m (NGVD)
1	0100-Along Cross Result								0	North	3	S	
		24	S			17	S				1	on	
	0700-Along Cross Result	0			128	0					3	205	
		24	160			17	160				1	on	
	1300-Along Cross Result										3	178	
											5	S	
	1900-Along Cross Result										1	off	
											5	149	
2	0100-Along Cross Result										4	N	
											2	on	
	0700-Along Cross Result	68	S			68	S		79	S	19	313	
		10	off		140	41	off				2	N	
		68	151			79	129				2	on	
	1300-Along Cross Result										3	295	
											28	S	
2	1900-Along Cross Result										1	off	
											28	158	
3	0100-Along Cross Result										16	S	
											2	on	
	0700-Along Cross Result	51	S			87	S		18	S	16	167	
		20	off		165	52	off				18	S	
		55	138			102	129				1	off	
	1300-Along Cross Result										18	157	
											23	S	
3	1900-Along Cross Result										1	on	
											23	162	
	4 0100-Along Cross Result										41	S	
											2	off	
4	0700-Along Cross Result	47	S			36	S		52	S	38	157	
		19	on		165	7	on				1	N	
		51	182			37	171				30	on	
	1300-Along Cross Result										22	S	
											4	on	
4	1900-Along Cross Result										22	170	
											3	S	
	5 0100-Along Cross Result										4	on	
											5	213	
5	0700-Along Cross Result	8	S			61	S		17	S	2	N	
		0	on		152	24	on				4	on	
		8	160			66	182				4	277	
	1300-Along Cross Result										5	N	
											7	323	
5	1900-Along Cross Result										0	N	
											7	340	
											10	N	
											5	on	
											11	313	

KEY = All speeds in CM/SEC
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
Jun 1988

Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter at South Tripod Depth -4.8m (NGVD) ID #679	
	Alongshore Cross-shore Resultant Time	Dye at (579 m) (surface)	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
6 0100-Along Cross Result									15	N
6 0700-Along Cross Result		10 11 15	N off 28	— 140	12 7 14	N off 11	0	South	7 17 11	on 315 N
6 1300-Along Cross Result									13	308
6 1900-Along Cross Result									4 2 4	N on 313
7 0100-Along Cross Result									1 3 3	S on 232
7 0700-Along Cross Result		0 0 0	— 128 0	— 0 0	0 0 0	— South 0	5 4 6	— South 0	3 4 5	N on 301
7 1300-Along Cross Result									5 2 5	S off 138
7 1900-Along Cross Result									11 1 11	S off 155
8 0100-Along Cross Result									9 1 9	S on 166
8 0700-Along Cross Result		44 11 45	S off 146	— 128 —	5 0 5	N — 340	0 North	— North	21 1 21	S off 157
8 1300-Along Cross Result									14 3 14	S on 172
8 1900-Along Cross Result									16 1 16	S on 164
9 0100-Along Cross Result									10 4 11	S on 182
9 0700-Along Cross Result		0 14 14	— off 70	— 128 —	28 4 28	N off 349	14 — N	— South	11 0 11	S — 160
9 1300-Along Cross Result									28 4 28	S off 152
9 1900-Along Cross Result									34 4 34	S off 153
10 0100-Along Cross Result									16 3 16	S off 149
10 0700-Along Cross Result		47 7 47	S on 169	— 152	68 41 79	S on 191	50 S North	— — North	24 2 24	S off 155
10 1300-Along Cross Result									16 1 16	S off 156
10 1900-Along Cross Result									12 0 12	S — 160

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 on = onshore off = offshore

Table 4: Current Data (Continued)
Jun 1988

Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter at South Tripod Depth -4.8m (NGVD) ID #679	
	Dye at (579 m) (surface)	Dye at (579 m) (surface)	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
Day	Speed	Dir	Speed	Dir			Speed	Dir	Speed	Dir
11 0100-Along Cross Result									3	N
11 0700-Along Cross Result	61 6	S on	165	68 0	S		61	S	19 3	340 off
11 1300-Along Cross Result	61	166		68	160		North		19 1	151 off
11 1900-Along Cross Result									21 1	157 off
12 0100-Along Cross Result									19	157
12 0700-Along Cross Result	15 5	S off	128	15 7	N off		30	N	1 0	S off
12 1300-Along Cross Result	15	141		16	4		South		6 6 8	160 115 232
12 1900-Along Cross Result									1 0 3	N off 340
13 0100-Along Cross Result									5 0 5	N off 340
13 0700-Along Cross Result	5 8 9	S off 104	116	0 0 0			0	South	1 1 1	N off 25
13 1300-Along Cross Result									2 0 2	N off 340
13 1900-Along Cross Result									3 3 4	N on 295
14 0100-Along Cross Result									6 0 6	N off 340
14 0700-Along Cross Result	9 13 16	N off 36	128	0 6 6	off 70		5	S	1 3 3	N on 268
14 1300-Along Cross Result									13 4 14	N off 357
14 1900-Along Cross Result									6 2 6	N on 322
15 0100-Along Cross Result									4 1 4	N on 326
15 0700-Along Cross Result	20 12 24	N off 11	128	0 0 0			0	South	4 1 4	N on 326
15 1300-Along Cross Result									10 2 10	N off 351
15 1900-Along Cross Result									9 4 10	N on 316

KEY = All speeds in CM/SEC
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 on = onshore off = offshore

Table 4: Current Data (Continued)
Jun 1988

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter at South Tripod Depth -4.8m (NGVD) ID #679		
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
16 0100-Along Cross Result										4	N
16 0700-Along Cross Result		12 4 off	N 128		41 8 off	N 351		12 N	South	3	on
16 1300-Along Cross Result		12 357			41 351					5	303
16 1900-Along Cross Result										2	on
17 0100-Along Cross Result										5	318
17 0700-Along Cross Result		16 7 off	N 152		16 2	N on		40 N	South	0	340
17 1300-Along Cross Result		17 4			17 331					21	N
17 1900-Along Cross Result										21	340
18 0100-Along Cross Result										11	340
18 0700-Along Cross Result		14 2 on	N 177		13 6	N on		61 N	South	4	N
18 1300-Along Cross Result		14 331			15 313					3	on
18 1900-Along Cross Result										5	303
19 0100-Along Cross Result										7	295
19 0700-Along Cross Result		9 9 off	N 152		38 0	N 340		14 N	South	4	N
19 1300-Along Cross Result		12 25			38 340					0	340
19 1900-Along Cross Result										8	S
20 0100-Along Cross Result										2	off
20 0700-Along Cross Result		9 15 off	N 165		23 15	N off		40 N	South	9	146
20 1300-Along Cross Result		17 39			27 13					4	N
20 1900-Along Cross Result										0	340

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Table 4: Current Data (Continued)
Jun 1988

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter at South Tripod Depth -4.8m (NGVD) ID #679				
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	Speed	Dir
21	0100-Along Cross Result											7	N
												6	on
												9	299
21	0700-Along Cross Result	9 19 21	N off 45		165	7 5 8	N off 17		38 South	N		7 5 9	N on 304
21	1300-Along Cross Result											4 3 5	N on 303
21	1900-Along Cross Result											12 0	N
												12	340
22	0100-Along Cross Result											4 5 6	N on 289
22	0700-Along Cross Result	12 7 13	N off 11		165	12 2 12	N off 349		30 South	N		5 5 7	N on 295
22	1300-Along Cross Result											1 3 3	N on 268
22	1900-Along Cross Result											15 3 15	N on 329
23	0100-Along Cross Result											11 6 13	N on 311
23	0700-Along Cross Result	29 13 32	N off 4		165	29 12 31	N off 2		46 South	N		13 4 14	N on 323
23	1300-Along Cross Result											5 3 6	N on 309
23	1900-Along Cross Result											4 3 5	N on 303
24	0100-Along Cross Result											1 1 1	N off 25
24	0700-Along Cross Result	23 7 24	S on 177		165	76 19 79	S on 174		99 North	S		18 3 18	S off 151
24	1300-Along Cross Result											13 11 17	S off 120
24	1900-Along Cross Result											41 5 41	S off 153
25	0100-Along Cross Result											20 5 21	S off 146
25	0700-Along Cross Result	51 0 51	S 0 160		152	61 18 64	S on 177		14 North	S		25 2 25	S off 155
25	1300-Along Cross Result											12 5 13	S off 137
25	1900-Along Cross Result											9 2 9	S on 173

KEY = All speeds in CM/SEC
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

Table 4: Current Data (Concluded)
Jun 1988

Alongshore Cross-shore Resultant Time Day	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter at South Tripod Depth -4.8m (NGVD) ID #679	
	Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
26 0100-Along Cross Result										10	N
										3	on
										10	323
26 0700-Along Cross Result	32	N				30	N	64	N	6	N
	16	off		152		0		South		5	on
	36	7				30	340			8	300
26 1300-Along Cross Result										13	N
										5	on
										14	319
26 1900-Along Cross Result										3	N
										2	on
										4	306
27 0100-Along Cross Result										8	N
										3	on
										9	319
27 0700-Along Cross Result	36	S				122	S	North	125	S	10
	11	on		165		73	on			5	off
	37	177				142	191			11	133
27 1300-Along Cross Result										15	S
										5	off
										16	142
27 1900-Along Cross Result										11	S
										1	off
										11	155
28 0100-Along Cross Result										0	
										2	off
										2	70
28 0700-Along Cross Result	17	S				12	S	North	67	N	10
	2	off		140		4	off			2	off
	18	154				13	143			10	149
28 1300-Along Cross Result										23	S
										10	off
										25	137
28 1900-Along Cross Result										0	
										0	
										0	
29 0100-Along Cross Result										5	N
										0	
										5	340
29 0700-Along Cross Result	13	N				55	N	South	44	N	3
	12	off		165		17	off			3	on
	18	22				58	357			4	295
29 1300-Along Cross Result										11	N
										5	on
										12	316
29 1900-Along Cross Result										17	N
										0	
										17	340
30 0100-Along Cross Result										10	N
										4	on
										11	318
30 0700-Along Cross Result	12	N				38	N	South	14	N	2
	0	off		140		0				2	on
	12	340				38	340			3	205
30 1300-Along Cross Result										5	S
										5	off
										7	115
30 1900-Along Cross Result										8	N
										5	off
										9	12

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PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) taken at the seaward end of the pier are made of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves). The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are made daily at the seaward end of the FRF pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Jun 1988

Day	Time	Wave Approach Angle at Pier End deg from True N		Radar Wave Angle deg from True N	Width of Surf Zone, m	Water Characteristics at Pier End		
		Primary	Secondary			Temp., C	Density g/cc	Secchi Vis., m
1	0700	10	90		14	20.6	1.0174	4.3
2	0735	60	90	90	83	19.5	1.0180	2.4
3	0705	60	30	60	169	20.0	1.0180	1.5
4	0720	80	40	80	225	17.5	1.0192	0.9
5	0800	60	10		138	17.0	1.0224	0.9
6	0700	90			39	16.7	1.0232	1.2
7	0655	0	80		3	18.4	1.0230	1.8
8	0700	20	80		3	20.6	1.0208	2.4
9	0700	10	60		7	20.6	1.0206	3.4
10	0700	50	20	60	127	18.9	1.0207	1.2
11	0800	0			133	18.9	1.0211	0.9
12	0700	10	90		10	19.5	1.0204	4.0
13	0630	none visible			4	18.9	1.0214	2.7
14	0630	none visible			3	18.4	1.0226	4.0
15	0630	none visible			4	18.4	1.0234	4.3
16	0630	125			5	17.5	1.0237	3.4
17	0630	95	120		77	17.2	1.0237	3.4
18	0800	70			101	16.7	1.0242	2.1
19	0800	80				17.8	1.0236	1.8
20	0630	90	60		92	18.6	1.0226	1.8
21	0630	none visible			65	17.2	1.0243	2.1
22	0630	100	130		52	16.7	1.0246	2.4
23	0635	105	90		75	16.7	1.0242	1.8
24	0630	40	70		193	16.4	1.0248	1.2
25	0845	35			134	22.8	1.0183	2.1
26	0645	60	120		55	20.0	1.0226	1.8
27	0653	20			123	20.6	1.0230	3.7
28	0635	50			77	20.6	1.0230	5.2
29	0635	95			93	21.4	1.0224	1.5
30	0630	100	70		42	21.4	1.0226	3.7

PART VI: WATER LEVELS

The National Ocean Services (NOS) has established a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect data every 6 minutes throughout the month.

Figure 4 shows the variation in mean water levels computed over a tidal cycle period (12.42 hours) and contains a list of selected mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water levels.

Table 6 contains the time of the center of each sampling interval and the range, high, low, and mean water levels during each tidal cycle.

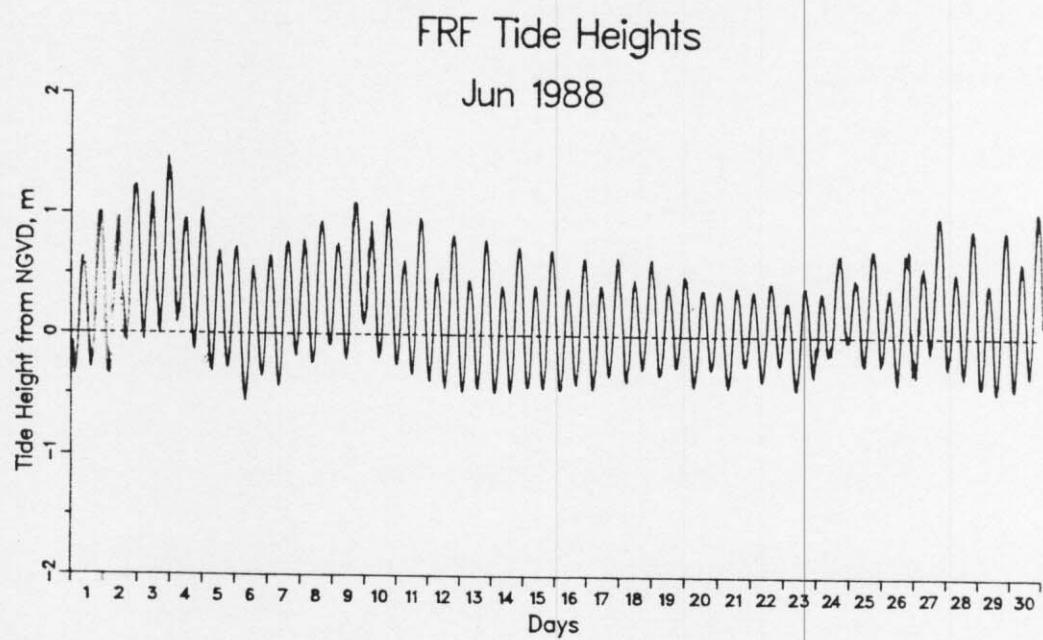


Figure 4. Time history of mean water levels

Monthly Water Levels, m NGVD

Extreme Low	=	-0.55	on day	6	at	624 hr
Extreme High	=	1.47	on day	3	at	2118 hr
Monthly Mean	=	0.20				
Mean Low	=	-0.30				
Mean High	=	0.69				
Mean Range	=	1.00				

Table 6: Water Levels, m NGVD

		Jun 1988			
Mid-Cycle Day	Time	Low	High	Mean	Range
1	612	—	—	—	—
1	1837	-0.29	1.01	0.39	1.30
2	703	-0.34	0.97	0.28	1.31
2	1928	-0.08	1.23	0.62	1.31
3	753	-0.05	1.16	0.51	1.22
3	2018	0.00	1.47	0.77	1.48
4	843	0.09	0.95	0.50	0.87
4	2109	-0.14	1.05	0.43	1.18
5	934	-0.31	0.69	0.19	1.00
5	2159	-0.28	0.72	0.19	1.00
6	1024	-0.55	0.57	0.02	1.12
6	2249	-0.35	0.65	0.16	1.00
7	1115	-0.43	0.76	0.21	1.19
7	2340	-0.18	0.78	0.29	0.96
8	1205	-0.24	0.94	0.37	1.17
9	30	-0.09	0.76	0.32	0.85
9	1255	-0.21	1.10	0.49	1.30
10	121	0.09	0.94	0.44	0.85
10	1346	-0.19	1.05	0.42	1.24
11	211	-0.25	0.62	0.18	0.86
11	1436	-0.33	0.97	0.35	1.30
12	301	-0.38	0.52	0.07	0.90
12	1527	-0.44	0.83	0.21	1.27
13	352	-0.47	0.46	0.01	0.93
13	1617	-0.45	0.79	0.19	1.24
14	442	-0.48	0.41	-0.03	0.89
14	1707	-0.47	0.73	0.15	1.20
15	532	-0.44	0.41	-0.02	0.85
15	1758	-0.44	0.71	0.14	1.15
16	623	-0.45	0.40	-0.03	0.85
16	1848	-0.41	0.65	0.12	1.05
17	713	-0.45	0.42	0.00	0.87
17	1938	-0.34	0.66	0.15	0.99
18	804	-0.38	0.47	0.04	0.85
18	2029	-0.28	0.64	0.18	0.92
19	854	-0.33	0.44	0.05	0.77
19	2119	-0.26	0.50	0.11	0.77
20	944	-0.42	0.39	0.00	0.80
20	2210	-0.28	0.38	0.03	0.66
21	1035	-0.43	0.41	0.01	0.84
21	2300	-0.25	0.38	0.04	0.63
22	1125	-0.37	0.45	0.07	0.82
22	2350	-0.30	0.29	0.01	0.59
23	1216	-0.45	0.41	0.01	0.86
24	41	-0.34	0.37	0.02	0.71
24	1306	-0.16	0.69	0.27	0.84
25	131	-0.11	0.48	0.19	0.59
25	1356	-0.24	0.72	0.27	0.96
26	222	-0.24	0.40	0.06	0.65
26	1447	-0.39	0.73	0.20	1.12
27	312	-0.33	0.59	0.14	0.92
27	1537	-0.13	1.00	0.45	1.13
28	402	-0.26	0.54	0.12	0.80
28	1628	-0.34	0.90	0.31	1.24
29	453	-0.41	0.45	0.00	0.87
29	1718	-0.46	0.89	0.24	1.35
30	543	-0.44	0.64	0.10	1.08
30	1808	-0.33	1.05	0.40	1.38

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in May and the three surveys in June on profile line 188, located 517 m south of the pier. The only significant changes were the development of a small nearshore bar (160 to 200 m) and a small amount of erosion high on the foreshore (80 to 110 m) following a small storm on 3-4 June.

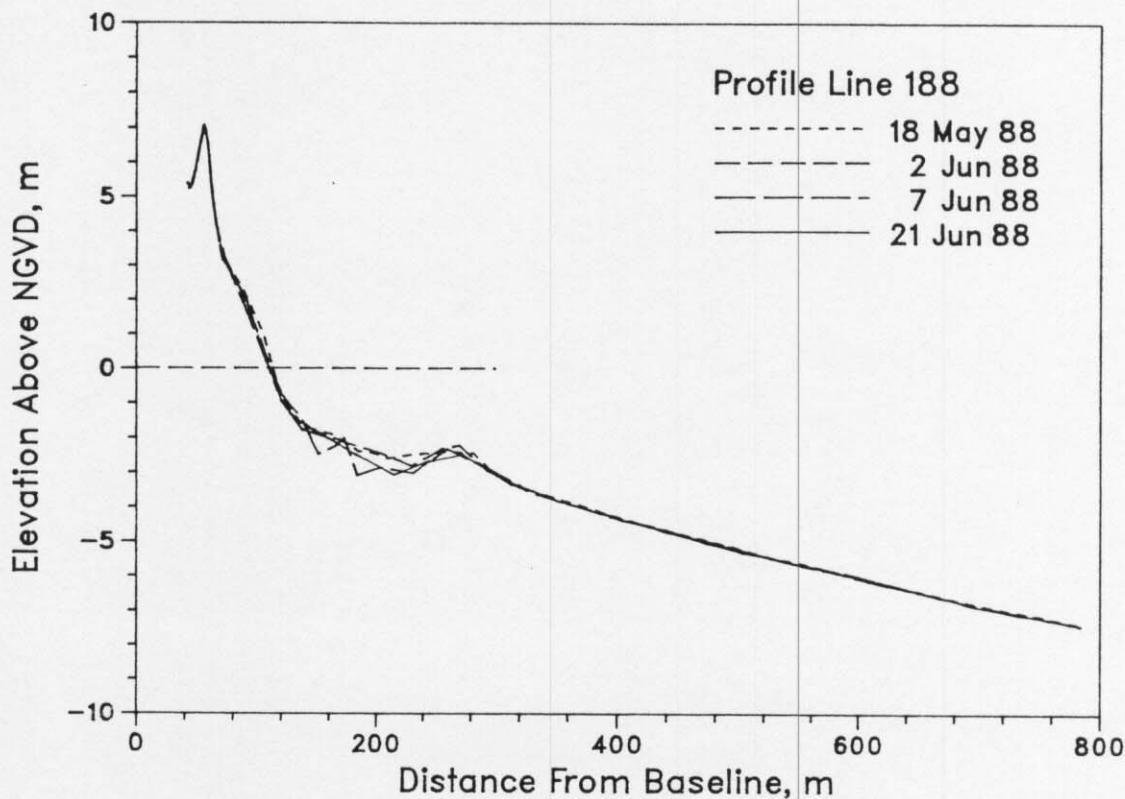


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1988. Both changes to the envelope reflect the storm's remolding of the bars.

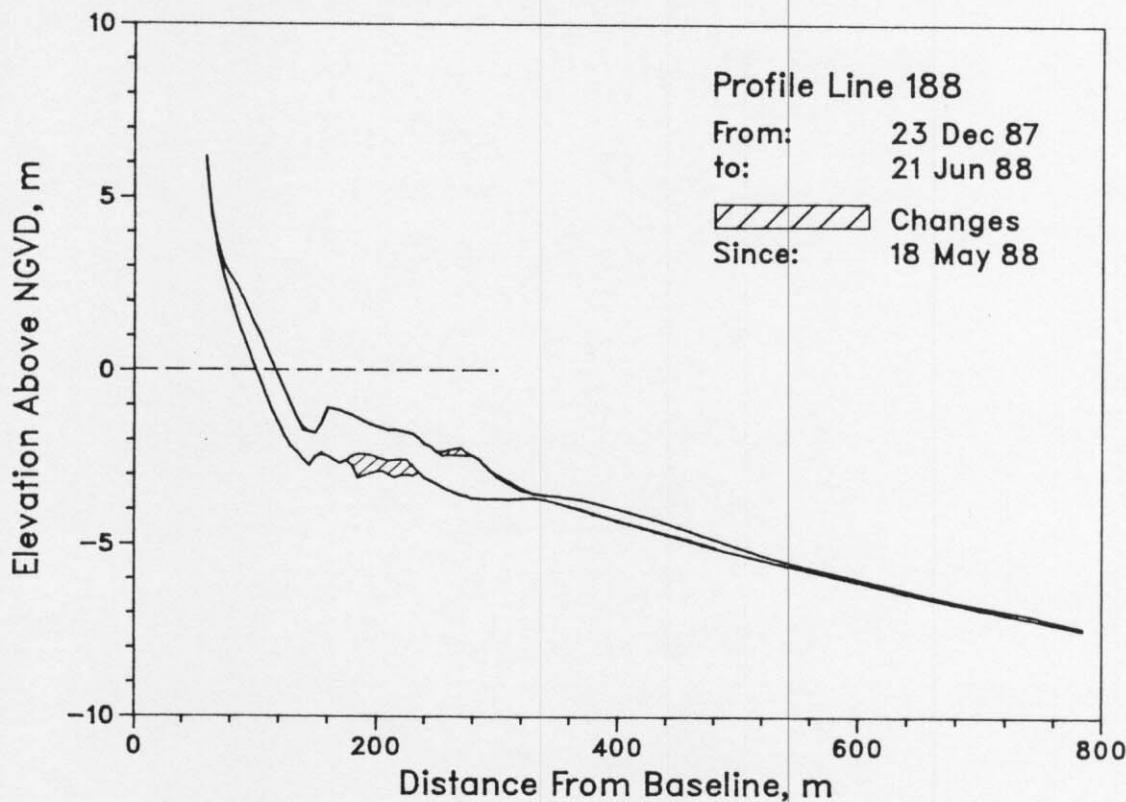


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey conducted on 8 June. Wide contour lines on the change diagram represent areas which eroded; thin lines indicate accretion.

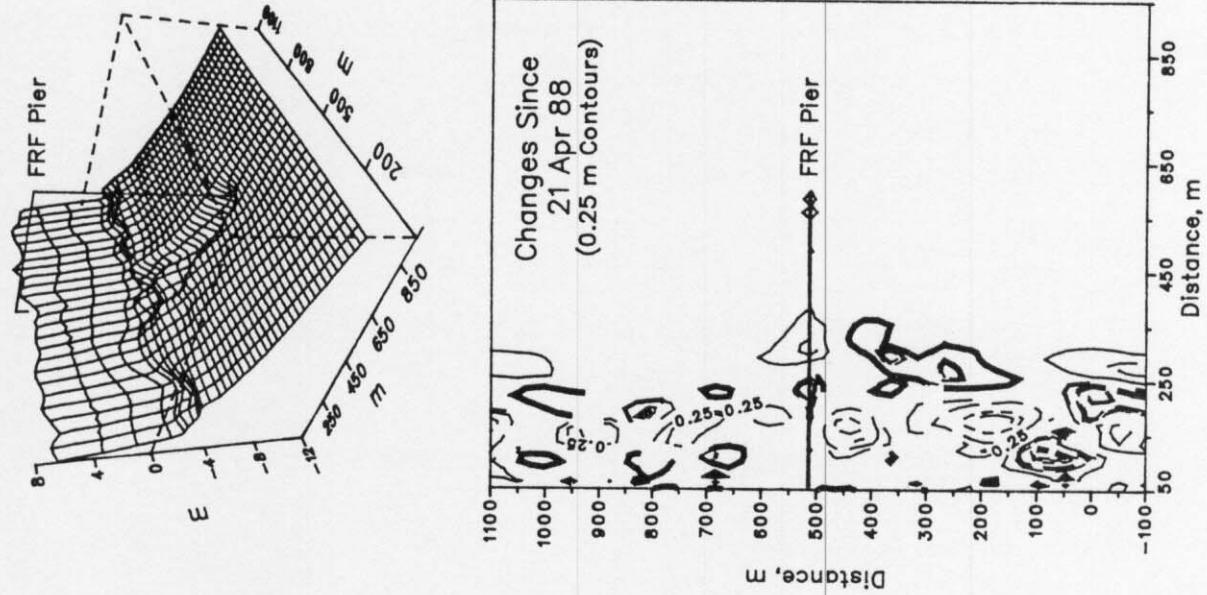
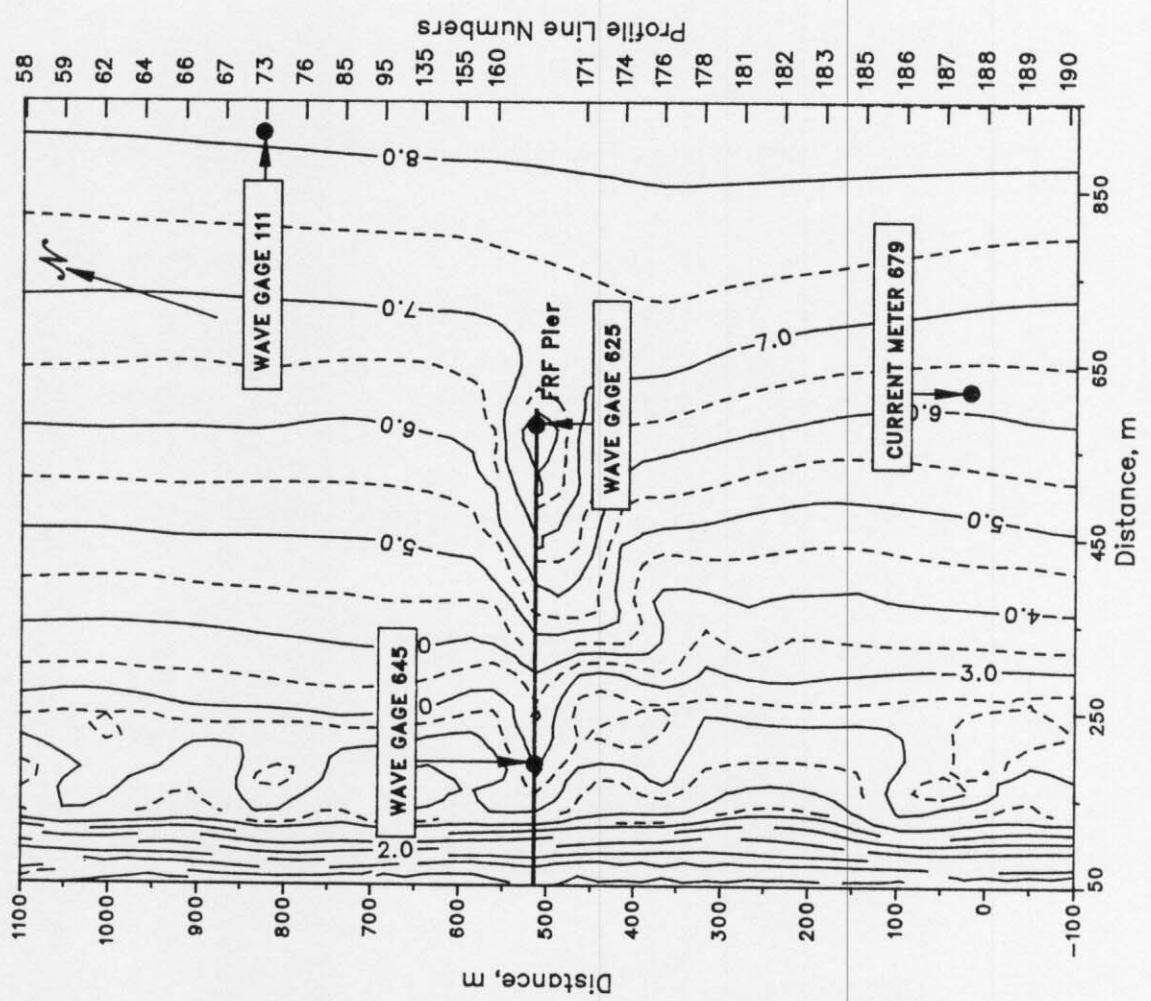


FIGURE 7. FRF BATHYMETRY 8 Jun 88
(Depths Relative to NGVD)

PART VIII: SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the wave height at the seaward end of the pier (i.e. as measured by Gage 625 at pier station 19+00) exceeded 2 m. When this occurred, four contiguous 34-min wave records were obtained every three hours:

<u>Start</u>	<u>End</u>
3 Jun (0842)	4 Jun (1600)

B. Storm Synopsis.

3-5 June - This small coastal storm developed off Cape Hatteras, NC early on 3 June and rapidly moved offshore. Maximum onshore winds (from north-northeast) exceeded 15 m/s at 1934 hr on 3 June. This was closely followed by the maximum H_{mo} of 2.40 m ($T_p = 7.53$ sec). Also on 3 June, the minimum barometric pressure of 1005.3 mb was recorded at 0842 hr. Total precipitation was 27 mm.

Distribution List

Government Agencies:

OCE	U.S. Geological Survey
BERH	U.S. National Park Service
NAO	U.S. Naval Academy
NASA/Wallops Flight Center	U.S. Naval Civil Eng. Lab
NOAA (NOS, NWS)	U.S. Naval Fac. Eng. Com.
SAD	U.S. Naval Oceanographic Off.
SAW	U.S. Naval Research Lab

Colleges/Universities:

California Inst. of Tech.	Stockton State College
East Carolina University	University of Akron
Florida Inst. of Tech.	University of Delaware
Harvard University	University of Florida
Naval Post Graduate School	University of Maryland
NC State University	University of Miami
Old Dominion University	University of North Carolina
Oregon State University	University of N. Colorado
Prince George's College	University of Rhode Island
Rutgers University	University of Virginia
Scripps Inst. of Oceanography	Va. Inst. of Marine Science
Southern Illinois University	

Others:

City of Va. Beach, VA	MEC Systems Corporation
Coastal Barge Corporation	Moffatt & Nichol, Eng.
Coastal and Est. Res., Inc.	Offshore Coastal Technologies
Coastal Science & Eng., Inc.	Mr. Rowland
Dr. Galvin	Mr. Savage
GEOMET Tech., Inc.	Sea Port Supply Corp.
Greenhorne & O'Mara, Inc.	Shell Development
Dr. Hylton	Sherwood Industries
Mary Marr, Inc.	Mr. & Mrs. Valpey
Masonite Corporation	WCTI-TV

Foreign:

W. F. Baird & Asso. Coastal Engineers, Ltd (Canada)
Queen's University, Ontario (Canada)
Ministry of Construction, Coastal Division (Japan)
Norwegian Hydrodynamic Laboratories (Norway)
University of New South Wales (Australia)
University of Sydney (Australia)